



RESEARCH ARTICLE

# Socioeconomic disparities in income, education and geographic location for hypertension among Thai adults: Results from the National Socioeconomic Survey [version 1; referees: 2 approved, 1 approved with reservations]

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**v1** First published: 13 Oct 2017, 6:1836 (doi: [10.12688/f1000research.12709.1](https://doi.org/10.12688/f1000research.12709.1))  
 Latest published: 13 Oct 2017, 6:1836 (doi: [10.12688/f1000research.12709.1](https://doi.org/10.12688/f1000research.12709.1))

**Abstract**

**Background:** Hypertension (HT) has been one of the leading global risk factors for health and the leading cause of death in Thailand for decades. The influence of socioeconomic factors on HT has been varied and inconclusive. The aim of this study was to determine the association between socioeconomic determinants and HT in Thailand.

**Methods:** This study used data from the National Socioeconomic Survey, a cross-sectional study that was conducted by the National Statistical Office of Thailand in the years 2005, 2006 and 2007. In our analysis, data were collected on gender, age, marital status, smoking status, education, status of work, occupation, current liability (short-term debt), household monthly income, residential area, region and previously diagnosed HT by a physician.

**Results:** The odds of having HT were significantly higher among those who had household monthly income, education, residential area and region. The participants who had monthly income of <10001 baht (2005: AOR = 3.19, 95%CI:1.47 - 6.92; 2006: AOR 2.53, 95%CI:1.37 - 4.69; 2007: AOR = 3.35, 95%CI: 1.97 - 7.00), were living in Bangkok compared with the Northeast region (2005: AOR = 1.72, 95%CI:1.37 - 2.17; 2006: AOR = 2.44, 95%CI: 1.89 - 3.13; 2007: AOR = 2.63, 95%CI 2.08 - 3.45), lived as an urban resident (2005: AOR= 1.32, 95%CI: 1.12 - 1.56; 2006: AOR= 1.21, 95%CI: 1.02 - 1.43; 2007: AOR= 1.47, 95%CI: 1.18 - 1.62), and finished primary education (2005: AOR =1.21, 95%CI: 1.03 - 1.43; 2006: AOR= 1.23, 95%CI: 1.04 - 1.46; 2007: AOR= 1.18, 95%CI: 1.01 - 1.38) when controlling for other covariates.

**Conclusion:** This study indicated that socioeconomic disparity has an influence on HT. Those with low educational attainment, low income, lived in urban regions, and were metropolitan residents (Bangkok) were vulnerable to HT.

**Open Peer Review**

Referee Status: ? ✓ ✓

	Invited Referees		
	1	2	3
<b>version 1</b>	?	✓	✓
published	report	report	report
13 Oct 2017			

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**Competing interests:** No competing interests were disclosed.

**How to cite this article:** Singsalasang A, Laohasiriwong W, Puttanapong N *et al.* **Socioeconomic disparities in income, education and geographic location for hypertension among Thai adults: Results from the National Socioeconomic Survey [version 1; referees: 2 approved, 1 approved with reservations]** *F1000Research* 2017, **6**:1836 (doi: [10.12688/f1000research.12709.1](https://doi.org/10.12688/f1000research.12709.1))

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**Grant information:** This research was financially supported by the Research and Training Center for Enhancing Quality of Life for Working Age People (grant number, 6101/2015).

*The funders had no role in study design, data collection and analysis, decision to publish, or preparation of the manuscript.*

**First published:** 13 Oct 2017, **6**:1836 (doi: [10.12688/f1000research.12709.1](https://doi.org/10.12688/f1000research.12709.1))

## Introduction

Hypertension (HT) is one of the top modifiable risk factors for cardiovascular diseases (CVD), a cause of morbidity and mortality worldwide<sup>1,2</sup>. In Thailand, statistics for 2003, 2008 and 2013 indicated that the morbidity rate per 100,000 population for HT were 389.80, 860.53 and 1621.72, respectively, which shows an exponential increase<sup>3</sup>. In 2025, HT patients will likely to increase to 1.56 billion cases globally<sup>4</sup>. Moreover, half of HT patients die from ischemic heart disease and stroke caused by HT<sup>3,4</sup>. Many studies had found that there were several factors related to the occurrence of HT. There are some known individual factors consisting of the non-modifiable factors of age<sup>5-9</sup>, gender<sup>5,7-11</sup>, and having a family history of HT<sup>9,11,12</sup>, and some behavioural, modifiable factors, including being overweight/obese<sup>6,7,10,12-14</sup>, smoking<sup>11,15</sup>, physical inactivity<sup>5,11</sup>, high dietary salt intake<sup>5,15</sup>, alcohol consumption<sup>9,12,16,17</sup>, and stress<sup>6</sup>. There are also factors of socioeconomic status (SES) that are correlated with HT, namely education<sup>6-9,12,18-20</sup>, occupation<sup>6,9,15</sup>, economic status<sup>17,21,22</sup>, income<sup>17,20</sup>, and residential area<sup>6,11,15,16</sup>. Therefore, there are a variety of factors, both individual and SES, that have been previously associated with HT.

Previous studies on HT in Thailand<sup>5,11,17</sup> were inconclusive regarding whether SES has any influence on HT. Studies on the association between SES and HT have been sparse, and the results are conflicting. Therefore, a large-scale study on HT and more focused research to determine whether disparity in socioeconomic effects on health status is needed. For these reasons, the objective of this study is to examine the association between the SES and HT among the Thai adult people.

## Methods

This study used data from the **National Socioeconomic Survey (NSS)**, conducted in 2005, 2006 and 2007 by the National Statistical Office (NSO) of Thailand. The questionnaires collected information on gender, age, marriage status, smoking status, education, occupational, status of work, household monthly income, current liabilities (short-term debt), residential area, region and previously diagnosed HT by a physician. The outcome, HT, was classified into two categories: having HT and not having HT.

### Study design and sample size

The cross-sectional survey was conducted by the NSO of Thailand. The survey used a stratified two-stage random sampling technique to select a nationally representative sample to respond to a structured questionnaire from all 76 provinces in Thailand. There were altogether 76 strata, each stratum was divided into two parts according to the type of local administration, namely, municipal areas and non-municipal areas. Selection of primary sampling, i.e. the sample selection of blocks/villages, was performed separately and independently in each part using probability proportional to the total number of households in that block or village. In the second step, the selection of secondary sampling

units, i.e. private sampled households, were selected using the systematic method in each type of local administration (details of this sampling are available at [http://web.nso.go.th/survey/house\\_seco/meth.pdf](http://web.nso.go.th/survey/house_seco/meth.pdf)). Ultimately, there were a total of 16,306, 16,539 and 16,488 participants in 2005, 2006 and 2007, respectively, who met the inclusion criteria of Thai nationality and aged 15 years old and above were included in this analysis.

### Statistical analysis

The characteristics of the participants were described using frequency and percentage for categorical variables and the mean and standard deviation for continuous variables. Crude odds ratios (OR), adjusted odds ratios (AOR) and 95% confidence intervals (CI) were calculated using bivariate and multiple logistic regression analysis to estimate the association between independent variables with HT. To obtain AOR for the effects of independent variables on HT, variables were placed in an initial model, and those with a p-value less than 0.25 were included in multivariate modelling. Backward elimination was used as the method for variable selection to obtain the final model. All analyses were performed using Stata version 13.0 (Stata Corp, College Station, TX). The magnitudes of effects were determined using AOR and 95% CI. A p-value less than 0.05 was considered statistically significant. All statistical tests were two-sided.

### Ethical statement

The NSS study obtained signed consent forms before enrolling participants. Confidentiality of the data was fully assured. The Ethical Committee of Khon Kaen University approved the exemption for ethical approval of this study (reference no. HE 582314). The NSO administrative board approved the research team to use the data (reference no.050601/1441).

## Results

The baseline characteristics of the 16,306 participants in 2005, the 16,539 participants in 2006 and the 16,488 participants in 2007 were as follows: The majority of the participants were women (53.53%, 53.61%, 53.58%, respectively); average ages were  $42.23 \pm 16.99$  SD,  $42.56 \pm 17.17$  SD and  $43.04 \pm 17.39$  SD years old; most of the participants had monthly household income <10,001 baht (89.47%, 89.94%, 89.57%, respectively); about a half of participants completed primary education (55.08%, 54.10%, 53.27%, respectively); the majority lived in rural areas (60.70%, 61.72% and 62.77%, respectively); the highest proportion of participants was from the Northeast region (27.45%, 27.56% and 28.03%, respectively); prevalence of smoking was 28.92%, 28.27% and 26.98%, respectively (**Table 1**).

The bivariate analysis indicated that gender, age, marital status, smoking status, education, occupation, household monthly income, current liability, residential area and region were significantly (p-value <0.25) associated with HT in three consecutive years (**Table 2**).

**Table 1. Demographic and socioeconomic characteristics of participants in the National Socioeconomic Survey of Thailand for the years 2005–2007.**

Characteristics	2005 (n = 16,306)		2006 (n = 16,539)		2007 (n = 16,488)	
	N	%	N	%	N	%
<b>Gender</b>						
Male	7,577	46.47	7,673	46.39	7,653	46.42
Female	8,729	53.53	8,866	53.61	8,835	53.58
<b>Age (years)</b>						
<35	5,937	36.41	5,839	35.30	5,635	34.18
≥35 - <45	3,570	21.89	3,637	21.99	3,556	21.57
≥45 - <55	2,933	17.99	2,998	18.13	3,061	18.57
≥55 - <65	1,854	11.37	2,022	12.23	2,110	12.80
≥65	2,012	12.34	2,043	12.35	2,126	12.89
Mean (SD)	42.23 (16.99)		42.56 (17.17)		43.04 (17.39)	
Median (Min - Max)	41 (15 - 98)		41 (15 - 98)		42 (15 - 99)	
<b>Marriage status</b>						
Single	3,720	22.81	3,718	22.48	3,740	22.68
Married	10,708	65.67	10,886	65.82	10,719	65.01
Widowed/Separated	1,878	11.52	1,935	11.70	2,029	12.31
<b>Smoking status</b>						
No	11,590	71.08	11,864	71.73	12,040	73.02
Yes	4,716	28.92	4,675	28.27	4,448	26.98
<b>Education</b>						
High (Upper primary school)	7,325	44.92	7,592	45.90	7,705	46.73
Low (Primary School)	8,981	55.08	8,947	54.10	8,783	53.27
<b>Status of work</b>						
No	4,227	25.92	4,348	26.29	4,299	26.07
Yes	12,079	74.08	12,191	73.71	12,189	73.93
<b>Occupation</b>						
Government officer	1,082	6.64	3,267	19.75	1,133	6.87
Private business	2,698	16.55	1,308	27.66	3,222	19.54
Personnel/employee	3,347	20.53	3,653	22.09	3,132	19.00
Agriculture/labour	9,179	56.29	8,311	50.25	9,001	54.59
<b>Current liabilities (Short-term debt)</b>						
No	11,461	70.29	11,812	71.42	11,789	71.50
Yes	4,845	29.71	4,727	28.58	4,699	28.50
<b>Household monthly income (baht)</b>						
≥30001	300	1.84	281	1.70	325	1.97
≥20001 - <30001	418	2.56	409	2.47	390	2.37
≥10001 - <20001	999	6.13	974	5.89	1,005	6.10
<10001	14,589	89.47	14,875	89.94	14,768	89.57
Mean (SD)	3,741.27 (9,412.58)		3,549.46 (8,992.28)		3,624.93 (9,322.23)	
Median (Min - Max)	0 (0 - 345,000)		0 (0 - 325,000)		0 (0 - 325,000)	
<b>Residential area</b>						
Rural	9,897	60.70	10,208	61.72	10,349	62.77
Urban	6,409	39.30	6,331	38.28	6,139	37.23
<b>Region</b>						
Bangkok	3,797	23.29	3,670	22.19	3,478	21.09
Central	3,182	19.51	3,331	20.14	3,346	20.29
North	2,953	18.11	3,046	18.42	3,085	18.71
Northeast	4,476	27.45	4,558	27.56	4,622	28.03
South	1,898	11.64	1,934	11.69	1,957	11.87

**Table 2. Frequency of hypertension (HT) in participants of the National Socioeconomic Survey for the years 2005–2007.** This includes the odds ratio (OR) of having HT, with 95% confidence intervals (CI), for various characteristics of participants.

Characteristics	2005 (n = 16,306)			2006 (n = 16,539)			2007 (n = 16,488)		
	N	% with HT	OR (95% CI)	N	% with HT	OR (95% CI)	N	% with HT	OR (95% CI)
<b>Gender</b>									
Male	7,577	4.54	1	7,673	4.46	1	7,653	4.83	1
Female	8,729	8.41	1.69 (1.29 - 2.20)	8,866	7.77	1.81 (1.58 - 2.06)	8,835	8.67	1.87 (1.64 - 2.12)
<b>Age (years)</b>									
<35	5,937	0.91	1	5,839	0.50	1	5,635	0.53	1
≥35 - <45	3,570	3.75	4.25 (3.08 - 5.84)	3,637	2.91	6.01 (3.98 - 9.09)	3,556	2.70	5.18 (3.42 - 7.83)
≥45 - <55	2,933	8.73	10.42 (7.74 - 14.02)	2,998	7.87	17.11 (11.61 - 25.24)	3,061	8.40	17.12 (11.70 - 25.06)
≥55 - <65	1,854	12.73	15.89 (11.76 - 21.47)	2,022	13.06	30.08 (20.43 - 44.31)	2,110	13.98	30.37 (20.78 - 44.37)
≥65	2,012	19.78	26.84 (20.11 - 35.89)	2,043	19.38	48.17 (32.91 - 70.51)	2,126	21.54	51.30 (35.32 - 74.52)
<b>Marriage status</b>									
Single	3,720	2.07	1	3,718	1.37	1	3,740	1.55	1
Married	10,708	6.63	3.35 (2.65 - 4.26)	10,886	6.55	5.04 (3.78 - 6.71)	10,719	7.11	4.86 (3.71 - 6.36)
Widowed/Separated	1,878	15.50	8.68 (6.70 - 11.23)	1,935	13.80	11.51 (8.48 - 15.61)	2,029	15.57	11.71 (8.80 - 5.58)
<b>Smoking status</b>									
No	13,124	3.78	1	11,864	4.02	1	13,433	3.85	1
Yes	3,182	18.29	3.15 (2.78 - 3.57)	4,675	11.85	3.21 (2.83 - 3.65)	3,055	20.26	3.60 (3.19 - 4.07)
<b>Education</b>									
High (Upper primary school)	7,325	4.05	1	7,592	3.60	1	7,705	3.93	1
Low (Primary school)	8,981	8.70	2.25 (1.96 - 2.59)	8,947	8.47	2.48 (2.15 - 2.86)	8,783	9.48	2.56 (2.34 - 2.93)
<b>Status of work</b>									
No	4,227	10.81	1	4,348	10.58	1	4,299	11.54	1
Yes	12,079	5.14	0.45 (0.40 - 0.51)	12,191	4.68	0.42 (0.37 - 0.47)	12,189	5.25	0.42 (0.38 - 0.48)

Characteristics	2005 (n = 16,306)			2006 (n = 16,539)			2007 (n = 16,488)			p-value
	N	% with HT	OR (95% CI)	N	% with HT	OR (95% CI)	N	% with HT	OR (95% CI)	
<b>Occupation</b>										
Government officer	1,082	4.53	1	3,267	3.70	1	1,133	4.15	1	<0.001
Private business	2,698	2.67	0.58 (0.40 - 0.84)	1,308	2.22	0.59 (0.39 - 0.89)	3,222	2.33	0.55 (0.38 - 0.79)	
Personnel/employee	3,347	6.04	1.35 (0.98 - 1.86)	3,653	6.87	1.92 (1.54 - 2.40)	3,132	7.28	1.81 (1.32 - 2.50)	
Agriculture/labour	9,179	8.23	1.89 (1.41 - 2.54)	8,311	7.58	2.13 (1.75 - 2.60)	9,001	8.73	2.21 (1.64 - 2.98)	
<b>Household monthly income (baht)</b>										
≥30001	300	2.67	1	281	4.27	1	325	3.38	1	<0.001
≥20001 - <30001	418	4.55	1.74 (0.75 - 4.02)	409	3.42	0.79 (0.36 - 1.74)	390	4.62	1.38 (0.64 - 2.97)	
≥10001 - <20001	999	2.70	1.01 (0.46 - 2.26)	974	2.46	0.57 (0.28 - 1.15)	1,005	1.79	0.52 (0.24 - 1.11)	
<10001	14,589	7.02	2.76 (1.36 - 5.58)	14,875	6.59	1.58 (1.88 - 2.83)	14,768	7.37	2.27 (1.24 - 4.16)	
<b>Current liabilities</b>										
No	11,461	6.70	1	11,812	6.41	1	11,789	7.15	1	0.034
Yes	4,845	6.40	0.95 (0.83 - 1.09)	4,727	5.80	0.90 (0.78 - 0.94)	4,699	6.24	0.86 (0.75 - 0.99)	
<b>Residential area</b>										
Rural	9,897	6.28	1	10,208	5.81	1	10,349	6.19	1	<0.001
Urban	6,409	7.11	1.14 (1.01 - 1.30)	6,331	6.92	1.21 (1.06 - 1.37)	6,139	8.06	1.33 (1.18 - 1.50)	
<b>Region</b>										
Bangkok	3,797	6.45	1	3,670	6.76	1	3,478	7.65	1	<0.001
Central	3,182	8.01	1.26 (1.05 - 1.52)	3,331	7.39	1.10 (0.92 - 1.32)	3,346	8.67	1.15 (0.96 - 1.36)	
North	2,953	8.43	1.34 (1.11 - 1.60)	3,046	7.68	1.15 (0.95 - 1.38)	3,085	8.75	1.16 (0.97 - 1.38)	
Northeast	4,476	4.78	0.73 (0.60 - 0.88)	4,558	3.97	0.57 (0.47 - 0.69)	4,622	4.13	0.52 (0.43 - 0.63)	
South	1,898	6.06	0.94 (0.74 - 1.18)	1,934	6.31	0.93 (0.74 - 1.16)	1,957	6.08	0.78 (0.63 - 0.98)	

The final model of the multiple logistic regression analysis after adjusting for covariates, which included gender, age, and smoking status, indicated that in 2005, 2006 and 2007, the odds of having HT were significantly higher among those who had household monthly income <10001 baht<sup>18</sup> (AOR = 3.19; 95%CI: 1.47 to 6.92, AOR = 2.53; 95%CI: 1.37 to 4.69, and AOR= 3.35; 95%CI: 1.97 to 7.00, respectively), lived in Bangkok when compared with the Northeast region (AOR = 1.72; 95%CI: 1.37 to 2.17, AOR= 2.44; 95%CI: 1.89 to 3.13 and AOR=2.63; 95%CI: 2.08 to

3.45, respectively), lived in urban areas (AOR= 1.32; 95%CI: 1.12 to 1.56, AOR= 1.21; 95%CI: 1.02 to 1.43 and AOR= 1.47; 95%CI: 1.18 to 1.62, respectively), and only finished primary education (AOR =1.21; 95%CI: 1.03 to 1.43, AOR = 1.23; 95%CI: 1.04 to 1.46, and AOR= 1.18; 95%CI: 1.01 to 1.38 respectively). Other covariates that were statistically significant associated with HT were smoking (AOR= 3.78; 95%CI: 3.29 to 4.34, AOR= 3.86; 95%CI: 3.35 to 4.45 and AOR=4.00; 95%CI: 3.49 to 4.59, respectively), aged 35 to 44 years old when compared with younger age groups (AOR= 3.68; 95%CI: 2.65 to 5.09, AOR= 4.58; 95%CI: 2.99 to 7.01 and AOR= 3.89; 95%CI: 2.53 to 5.98, respectively), and women (AOR= 2.11; 95%CI:1.83 to 2.42, AOR= 2.11; 95%CI:1.81 to 2.44, and AOR= 2.05; 95%CI: 1.77 to 2.37, respectively) (Figure 1).

<sup>18</sup> The amount was equal to 248.35 US dollar, 263.68 US dollar and 289.35 US dollar, in year 2005, 2006 and 2007, respectively. These conversions used the official exchange rates obtained from the Bank of Thailand.

**In year 2005**

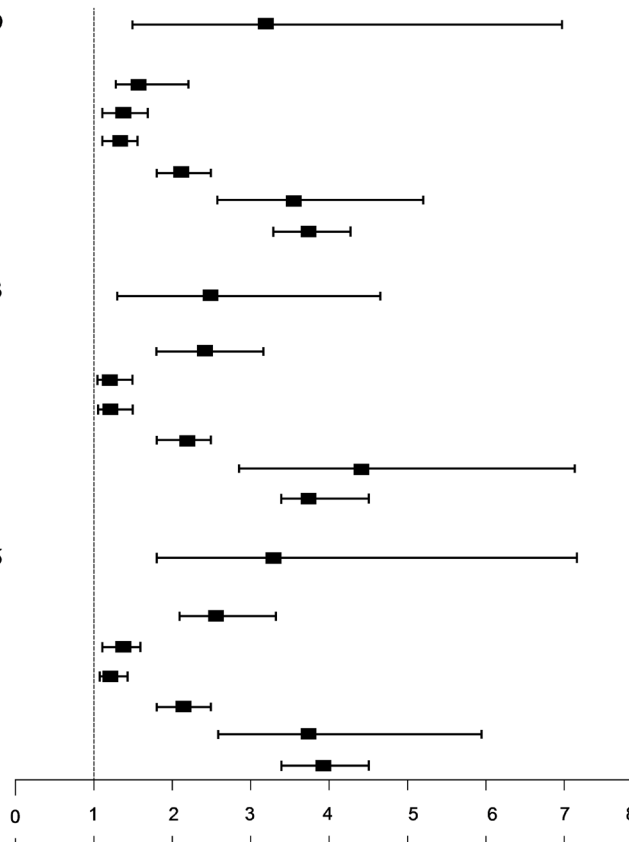
- Household monthly income<10001 Baht 3.19 (1.47 – 6.92)
- Lived in Bangkok 1.72 (1.37 - 2.17)
- Urban resident 1.32 (1.12 - 1.56)
- Finished primary education 1.21 (1.03 - 1.43)
- Female 2.11 (1.83 – 2.42)
- Age ≥ 35 - 44 years 3.68 (2.65 – 5.09)
- Smoking 3.78(3.29 – 4.34)

**In year 2006**

- Household monthly income<10001 Baht 2.53 (1.37 – 4.69)
- Lived in Bangkok 2.44 (1.89 - 3.13)
- Urban resident 1.21 (1.02 -1.43)
- Finished primary education 1.23 (1.04 - 1.46)
- Female 2.11 (1.81 – 2.44)
- Age ≥ 35 - 44 years 4.58 (2.99 – 7.01)
- Smoking 3.86 (3.35 – 4.45)

**In year 2007**

- Household Monthly income<10001 Baht 3.35 (1.97 - 7.00)
- Lived in Bangkok 2.63 (2.08 - 3.45)
- Urban resident 1.47 (1.18 - 1.62)
- Finished primary education 1.18(1.01 - 1.38)
- Female 2.05 (1.77 – 2.37)
- Age ≥ 35 - 44 years 3.89 (2.53 – 5.98)
- Smoking 4.00 (3.49 – 4.59)



**Figure 1.** Adjusted odds ratios and 95% confidence intervals for characteristics associated with hypertension in participants of the National Socioeconomic Survey for the years 2005–2007.

## Discussion

From the National Socioeconomic Survey data, we focused on examining the prevalence of HT and influences of SES on HT among Thai adults. HT is a common chronic disease and one of the most powerful contributors to CVD<sup>1,2</sup>. This study was conducted among the nationally representative samples with a large sample size; therefore, the results should be generalizable to represent the Thai population. In this study, SES factors, i.e. education, household monthly income, residential areas and region, were associated with HT even after adjusting for potential confounders.

Previous studies have revealed the association between the level of education and HT<sup>6-9,12,18-20,23</sup>, and they indicated that a low level of educational attainment was significantly associated with increased prevalence of HT. High education attainment is related to self-care and crucial to guarding against smoking. It can defeat related risk factors of HT by influencing a healthy lifestyle<sup>7,18,24</sup>. Moreover, sound knowledge on health can affect individual behaviour in several ways, such as involvement in health promotional activities and accessing health services<sup>24</sup>. Those with a higher education are provided with exponentially higher range and number of job opportunities and medical benefits packages, compared to those with lower levels of education. Another justification is that the higher education may promote the achievement of social gain, psychological support, and economic productivity by opening windows of opportunities. Thus, these performances can influence a person to socialize with peer groups that consequently promote good health behaviour, great self-esteem, and strong self-efficacy<sup>19,20,24</sup>.

Previous studies have reported that low income is associated with HT<sup>19,20</sup>. These findings are consistent with our study that participants with the low income had a higher risk of HT than those with a high income. As previously stated, a key factor is an income that can highly influence the behaviour. It can satisfy mental health, food behaviour, and make one aware of accessing health care to promote sound health<sup>19</sup>. Moreover, an income is essential to purchase better nutrition, high-quality education, healthy housing, and access to recreation. Previous studies also support these statements, saying that socioeconomic and psychosocial factors strongly affect individual health status<sup>20</sup>. Therefore, having a good income can be a useful measure to examine the variables that transform the health of the population<sup>19</sup>. A low income group have a higher tendency to develop HT and require treatment by changing lifestyles, such as weight loss, physical activity, and salt intake reduction<sup>20</sup>. It is highly important in terms of public health to identify these individuals so as to set up measures to delay or prevent HT progression or development.

The results of this study also showed that the residential area and region were significantly associated with HT. HT prevalence was highest among those who lived in the North than other regions and the lowest was in the Northeast. People who were living in Northeastern and Southern regions of Thailand were less likely to have HT than those living in Bangkok metropolitan area. Similarly, a previous study indicated that HT prevalence was correlated with geographical region<sup>25</sup>. For example, our study showed that there was the lowest prevalence of HT in the Northeast

region, similar to the findings of a survey in Thai health working groups and health behaviour<sup>26</sup> and the National Health Examination Survey<sup>25</sup>. In the Northeast, people were seldom aware that they had HT<sup>25</sup>, which is similar to the findings of the Health and Welfare Survey of the NSO, Thailand<sup>5</sup>. Residential areas where they lived could influence health behaviours in terms of lifestyle, social well-being and urbanization<sup>27</sup>. The results of this study corresponded to previous findings in Mae Hong Son province in Thailand<sup>11</sup>, Dehui City of Jilin province in China<sup>16</sup>, and North-west in Ethiopia<sup>16</sup>, which reported a significantly higher tendency of HT in urban areas or cities rather than rural areas. Urbanization was associated with eating habit changes and obesity caused by reduced physical activity. Thai people have changed eating habits according to changing lifestyles between urban and rural residents<sup>28</sup>. Such lifestyle and eating habit changes are conducive to a high prevalence of abdominal obesity in the urban population, eventually resulting in increased prevalence of HT. Similar to the previous study<sup>28</sup>, residents in urban areas have a higher prevalence of being overweight or obese when compared with rural residents<sup>15,18</sup>. The differences in job opportunities and the quality of education in urban areas possibly impose an influence on the average socioeconomic accomplishment of its residents. The quality of the neighbourhood environment may be influenced by different levels of inequality regarding the distribution of social and economic resources across metropolitan areas. There have also been links of several aspects of the residential context to disparities in CVD risk and HT, including neighbourhood poverty and disadvantages, neighbourhood social cohesion, walking ability, availability of a healthy diet, and safety<sup>18</sup>. The differences in environmental exposures are possibly linked to HT<sup>29</sup>. In addition, neighbourhood-level SES could differently affect healthcare accessibility. Adverse neighbourhoods can increase levels of stress, and induce negative health behaviours, while failing to perform health promoting behaviours, possibly leading to HT. This study revealed that HT, which varied by each residential area, depended on the socio-environmental context at both metropolitan and neighbourhood levels<sup>29</sup>.

In addition, the results from the multivariate analysis performed in this study indicated that covariate factors, such as gender, age and smoking, were strongly associated with HT. Women had a higher prevalence of HT than men over all three years, similar to the findings of a previous study in Thailand<sup>5</sup>. In women, hormonal change after menopause has an effect on increasing blood pressure. The walls of a woman's blood vessels can become less flexible when estrogen decreases, causing blood pressure (BP) to rise. The decline in estrogen levels can increase the risk for stroke and heart disease, especially due to high BP<sup>13</sup>. Moreover, an older age had significantly higher odds of having HT than younger individuals. These findings are consistent with previous studies<sup>5,6,9-12</sup>. In older individuals, arteries harden, kidney function decreases, the body has a greater sensitivity to salt and other factors, and there are hormonal changes, such as menopause. Furthermore, aging is also associated with a decrease in heart rate, intravascular volume, stroke volume, renal blood flow, plasma renin activity and cardiac output, and an increase in left ventricular mass index and renal vascular resistance, resulting in higher BP when a progressive decline in the ability of the kidneys to excrete



salt loads efficiently<sup>30</sup>. In addition, elderly individuals are less likely to be physically active, which is also one of risk factor of HT. Thus, aging individuals are more likely to have an increasing risk of HT<sup>6,17</sup>. Additionally, this study indicated that HT was more prevalent among smokers. Indeed, smoking, in the form of cigarette or tobacco, can influence the deterioration of the overall health condition. Almost all physical systems, such as cardiovascular, cerebrovascular, respiratory, digestive, endocrine, urogenital and reproductive organs, can be affected by the harmful constituents of smoking. Smoking is an influential risk factor for developing cardiovascular-related diseases and morbidities, and discontinuation or cessation of smoking behavior can limit the process of initiating HT<sup>28</sup>. Thus, smoking causes a series of actions, such as loss of endothelial functionality, arterial stiffness causation, and recurrence of inflammation within the body<sup>28</sup>.

### Limitations

This study analysed nationally representative sample information. The findings indicated an increasing trend of HT and the association between the socioeconomic disparities and HT. It is noted that some variables, such as health behaviours, were not included in the study. However, these variables were found not strongly related to HT in previous studies when compared with demographics and smoking that were included in this study. Anyhow, we suggest that additional research focusing on biomolecular milieu, prenatal and early life exposures, historic SES conditions, health behaviours and their interplay in patients with HT may broaden the knowledge of associations among SES disparities and HT.

### Conclusions

This study supports previous findings indicating that being a women, middle aged to elderly, and smoking are strongly associated with HT. The study also reported a new conclusion that socioeconomic factors had a significant influences on HT. Populations with low educational attainment, low income, urban, and metropolitan residents (Bangkok) were vulnerable to HT.

Above all, the interaction between SES and biology combined to accelerate bio-molecular characteristics that could differently impose influences on HT. These findings deliver important implications for future research and healthcare provision in relation to the prevention of HT. Health personnel and other relevant sectors should be aware of the significant roles of these SES disparities on HT in order to develop appropriate policies aimed at preventing HT.

### Data availability

Data used in this study were obtained from the NSO. Permission to use these data can be requested from the NSO. Researchers can request the NSS data by submitting an application form to the NSO Database Committee (the application form should be requested from the NSO Database Committee; [services@nso.go.th](mailto:services@nso.go.th)). More details for submitting a request can be obtained from the NSO's Statistical Information Service and Dissemination Group ([services@nso.go.th](mailto:services@nso.go.th)).

### Competing interests

No competing interests were disclosed.

### Grant information

This research was financially supported by the Research and Training Center for Enhancing Quality of Life for Working Age People (grant number, 6101/2015).

*The funders had no role in study design, data collection and analysis, decision to publish, or preparation of the manuscript.*

### Acknowledgements

The authors are grateful to all the contributors to this research, especially the National Statistical Office for the data, the Research and Training Center for Enhancing Quality of Life for Working Age People for the financial support and the Faculty of Public Health, Khon Kaen University, for financial and technical supports.

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# Open Peer Review

Current Referee Status:



Version 1

Referee Report 09 April 2018

doi:10.5256/f1000research.13767.r31475



**Abha Shrestha** <sup>1</sup>, **Anmol Shrestha**<sup>2</sup>

<sup>1</sup> Department of Community Programs, Dhulikhel Hospital, Kathmandu University Hospital, Dhulikhel, Nepal

<sup>2</sup> Department of General Practice, Dhulikhel Hospital, Kathmandu University Hospital, Dhulikhel, Nepal

The authors have presented the growing burden of hypertension in Thailand and its association with the socioeconomic status. The paper is relevant to the current scenario of increasing burden of Noncommunicable diseases.

1. I have a suggestion, please add the reference: Kearney et al. (2005)<sup>1</sup> to the reference number 4.
2. Since, this study is about hypertension, it would be nice to explain more on the diagnosis criteria used for hypertension.
3. The result section of the abstract is not very clear.

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**Is the work clearly and accurately presented and does it cite the current literature?**

Yes

**Is the study design appropriate and is the work technically sound?**

Yes

**Are sufficient details of methods and analysis provided to allow replication by others?**

Yes

**If applicable, is the statistical analysis and its interpretation appropriate?**

Yes

**Are all the source data underlying the results available to ensure full reproducibility?**

Yes

**Are the conclusions drawn adequately supported by the results?**

Yes

**Competing Interests:** No competing interests were disclosed.

**Referee Expertise:** Noncommunicable diseases

**We have read this submission. We believe that we have an appropriate level of expertise to confirm that it is of an acceptable scientific standard.**

Referee Report 06 February 2018

doi:10.5256/f1000research.13767.r30222



**Matthew Kelly**

National Centre for Epidemiology and Population Health, Australian National University, Canberra, ACT, Australia

The authors present a straightforward account of an important and growing health burden in Thailand, hypertension. Given the increasing prevalence of this condition and the associated increased risk for other chronic diseases this paper is timely and relevant. The identification of socio-economic drivers is particularly important in a country such as Thailand which has experienced rapid economic growth and change in the recent past.

I have a few comments as follows:

1. Why are the authors using 2005 to 2007 data? These data are now more than 10 years old and given the rapid rise in HT prevalence described by the authors the most up to date data are important.
2. The results section of the abstract needs to be rewritten. It describes associations between for example income and education and HT but does not describe the direction of the association. That is, high income or low income that associates with hypertension.
3. In the Methods HT is measured by self-report of a physician diagnosis. Has any validation analysis been done to assess the accuracy of this type of self report? Also this leaves the strong possibility of undiagnosed HT being prevalent in the community. This cannot be measured using this study design but it should be mentioned in the limitation section of the discussion.
4. Also in the Methods the authors describe a sample of approximately 16,000 people in each study year. What proportion is this of the total study population after exclusions were made.
5. Was there any non-response or refusal to participate rate that should be reported?
6. In the bivariate analysis variables were included where their association with hypertension was significant at  $p < 0.25$ . Why was this value chosen?
7. The Discussion section of this paper needs some work.
  - a. The authors discuss education and income as indicators of socio-economic status and observe that low education and low income are associated with HT risk. This is the case in contemporary

Thailand. It may be worth discussing here though that this is a modern phenomenon and the result of health and epidemiological transitions. Previously in most low and middle income countries chronic disease risk including obesity and HT was concentrated in the higher socio-economic groups.

b. There is a little bit of a contradiction between the education/ income – HT association and the geographic association which needs some more consideration. Incomes are generally higher in urban areas which should according to the SES hypothesis mean that they have the lowest levels of HT. However in this study, the Northeast, the poorest area of the country has the lower prevalence. As the authors suggest this could be because in Isan the undiagnosed HT may be higher. But there also may be different directions of association between income and HT depending where you live. I am not sure there will be a clear answer to this but it deserves some discussion in the paper.

**Is the work clearly and accurately presented and does it cite the current literature?**

Yes

**Is the study design appropriate and is the work technically sound?**

Yes

**Are sufficient details of methods and analysis provided to allow replication by others?**

Yes

**If applicable, is the statistical analysis and its interpretation appropriate?**

Partly

**Are all the source data underlying the results available to ensure full reproducibility?**

Partly

**Are the conclusions drawn adequately supported by the results?**

Yes

**Competing Interests:** No competing interests were disclosed.

**I have read this submission. I believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard.**

Referee Report 10 November 2017

doi:[10.5256/f1000research.13767.r27016](https://doi.org/10.5256/f1000research.13767.r27016)



**Limin Wang**<sup>1</sup>, **Yichong Li**<sup>2</sup>

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<sup>2</sup> Peking University Health Science Center, Beijing, China

Comments:

1. Language in abstract is unreadable, especially in the results part.
2. Please provide the sample size for each stage of sampling, if equal sample size strategy was used.
3. What is the ultimate sampling unit? If household, were all individuals in the selected household included in the survey?
4. Did the analysis take into account the multistage sampling design? If not, the present estimations were not reliable, as sampling error might get probably underestimated.
5. The results for every study year are much similar, and the SES effects on HT should not change during short period. So, what is the point of annually independent analysis?

**Is the work clearly and accurately presented and does it cite the current literature?**

Partly

**Is the study design appropriate and is the work technically sound?**

Partly

**Are sufficient details of methods and analysis provided to allow replication by others?**

Partly

**If applicable, is the statistical analysis and its interpretation appropriate?**

Yes

**Are all the source data underlying the results available to ensure full reproducibility?**

Yes

**Are the conclusions drawn adequately supported by the results?**

Partly

**Competing Interests:** No competing interests were disclosed.

**Referee Expertise:** I'm an epidemiologist and statistician on the field of chronic non-communicable diseases, including cardiovascular disease, diabetes ,endocrine disorders and related risk factors(such smoking, alcohol drinking, obesity ).

**We have read this submission. We believe that we have an appropriate level of expertise to confirm that it is of an acceptable scientific standard, however we have significant reservations, as outlined above.**

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